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Success of Saturn: A Case Study of the Saturn Automobile

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ABSTRACT

SUCCESS OF SATURN:

A CASE STUDY OF THE SATURN AUTOMOBILE

by Lt Col Allan M. Coleman, USAF

For nearly 50 years the U.S. was the leading producer of automobiles worldwide. By 1980 this dominance had shifted considerably with the Japanese taking the number one position from the U.S. American automobile manufacturers had been sleeping at the wheel while the Japanese developed the concept of lean manufacturing and produced quality, inexpensive, fuel efficient automobiles. They put their cars on the market in the U.S. and Americans bought Japanese instead of expensive, large, inefficient U.S. automobiles.

In mid 1982, General Motors launched a plan to combat the Japanese intrusion into the American market place. The plan was called the Saturn Corporation. It took eight years and a huge capital investment to produce the first car but the Saturn cars are cutting into the Japanese stronghold on the small car market in the U.S.

Saturn Corporation could become the model for General Motors divisions of the future. What has been learned at Saturn is shared, studied and incorporated where applicable in other GM motor divisions. This case study tells the Saturn story from it's inception to present (early 1993).

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SUCCESS OF SATURN:

A CASE STUDY OF THE SATURN AUTOMOBILE

WHY STUDY THE SATURN CASE?

America didn't invent the automobile, but there was a time when it was the world's leader in automotive design and manufacturing. U.S. auto makers shared their knowledge with Europe and Japan-- then, they paid no attention to what Japan did with what they learned. Japan took what they learned, added their culture and work ethic, and "ate U.S. auto makers for lunch." The U.S. produced 4 out of 5 automobiles sold in the world in 1940. By 1960, the U.S. share of the world market dropped to 50% and today our share has become a mere 25%. Has the U.S. lost the competitive edge?¹

Wake Up America

Finally, someone woke up and decided it was time to do something about the decline of U.S. prominence in the world automotive market place. In mid 1982, Alex C. Mair, and two other top GM engineers, discussed a new and innovative small car project.² It was from that discussion that the idea of the Saturn automobile was born.

The purpose of this case study is to stimulate thought about ways for U.S. manufacturers to regain the competitive edge in the

world market. The Saturn case is an excellent success story and contains many examples of philosophies and techniques that could be employed in both defense and non-defense industries. This case study is about the Saturn story of success and includes all areas of its short ten year history. It is an examination of the successes as well as the problems encountered along the road to success. The case study will begin with the birth of the idea and how organizational philosophies developed. It will cover site and leadership selection. A large portion of the study will center on new technologies and the manufacturing process developed by Saturn Corporation. The natural follow up is a discussion of the production of the first automobiles and a look at marketing, pricing and delivery to the customer. A thorough case study would be incomplete without an evaluation of the end product. The study concludes with Saturn sales, customer reaction to the product, and assesses the quality and performance of the Saturn automobile.

The time has arrived for the U.S. auto manufacturing industry to wake up and get competitive. It can't do this by using old thinking. Certainly much is known about manufacturing in this country. A lot can be learned by looking at what has or hasn't worked for others. New technologies need to be developed. Competitive information must be gathered. New management philosophies need to be studied and developed.³ It appears that Saturn Corporation's rockets are blazing and they are onto

something. Let's find out what it is.

THE BIRTH OF AN IDEA

CONCEPT DEVELOPMENT

Roger Smith, Chairman of the Board of General Motors, put together a team to carry forward the idea of a new and innovative small car project in June 1982.⁴ Their charge may well prove to be a giant step into the future for the U.S. auto industry. The team set out to prove that America could compete with foreign automakers and win in a battle for customers with a product made in America, by Americans, with nearly all American components.⁵ They created a new company called Saturn Corporation, "the first new GM nameplate since 1918."⁶

GM's Advanced Product Design Team began work on the Saturn project immediately. Their approach was one with a blank page. This approach allowed the team to develop their plan for a new car without the bias of deep seated industry thinking and practices.⁷ According to Jack O'Toole, Vice President of the United Auto Workers Union (UAW)/Peoples Systems, in a presentation at Stanford University in March 1990, "it was not an attempt to re-invent the wheel, but rather to see if there was a better way of applying technology and employing creative talent to achieve world-class quality in a cost-competitive manner, using an American labor force."⁸ The project team searched for a

balanced mix between people and technology and to optimize the best of both resources.'

What to do first? The Group of 99

It was clear to all involved that the first step was to get everyone dedicated to their common goal. Probably the most significant step taken would later prove key to the success of Saturn Corporation. An unprecedented alliance between GM and the UAW was forged. The result of this alliance was the formation of a group of GM and UAW people to bring about change. It became known as the "Group of 99" and was made up of a wide cross section of managers, union committeemen, production workers, and union and non-union staff personnel just to name a few. It was truly a mix from GM plants and union locals from across the country. Their charge was, "to identify and recommend the best approaches to integrate people and technology to competitively manufacture a small car in the United States."¹⁰ Perhaps the best illustration of what the "Group of 99" was all about is to state the group's philosophy which was used during the process.

We believe that all people want to be involved in decisions that affect them, care about their jobs, take pride in themselves and in their contributions and want to share in the success of their effort: By creating an atmosphere of mutual trust and respect, recognizing and utilizing individual expertise and knowledge in innovative ways, providing the technologies and education for each individual, we will enjoy a successful relationship and a sense of belonging to an integrated business system capable of achieving our common goals which insures

security for our people and success for our business and communities.¹¹

The "Group of 99" spent two months traveling over 2 million miles visiting GM plants and other companies in the U.S. and overseas. The purpose of these visits was to gather information on what works and doesn't work.¹² The results of their travels was a list of common threads of success. This list is taken from Jack O'Toole's presentation at Stanford University in March 1990.

COMMON THREADS OF SUCCESS¹³

- * Quality is a top priority to maintain customer satisfaction.
- * Ownership by all. Everyone is responsible.
- * Equality is practiced, not just preached.
- * Barriers to doing a good job are eliminated.
- * Total trust is a must.
- * People are the most important asset.
- * Union and management are partners and share in the responsibility for assuring success of the enterprise.
- * People are given responsibility and authority to do the job.
- * People will work together towards common goals under the right atmosphere of mutual trust and respect.
- * This can be achieved with people from a wide variety of cultures.
- * People will make personal sacrifices to achieve common goals if they believe their input is important and will be used.

The "Group of 99" learned what W. Edwards Deming knew long ago. In fact Deming offered his philosophies to Detroit some years ago and was rejected. He turned to Tokyo. Tokyo embraced Deming's ideas and produced success.¹⁴ The fruits of the "Group of 99's" labor show up in Saturn's Mission, Philosophy, and Values statements. All Saturn employees go through extensive training (350 hours), and during that training they are constantly exposed to the common threads of success and the Saturn mission, philosophy and values. They are even issued pocket size cards containing the information for quick reference.¹⁵

SATURN MISSION STATEMENT

To market vehicles developed and manufactured in the United States that are world leaders in quality, cost and customer satisfaction through the integration of people, technology and business systems and to transfer knowledge, technology and experience throughout General Motors.¹⁶

SATURN PHILOSOPHY

We, the Saturn team, in concert with the UAW and General Motors, believe that meeting the needs of customers, Saturn Members, Suppliers, Dealers and Neighbors is

fundamental to fulfilling our mission. By continuously operating according to this philosophy, we will fulfill our mission.¹⁷

SATURN VALUES¹⁸

We, at Saturn are committed to being one of the world's most successful car companies by adhering to the following values:

- * Commitment to customer enthusiasm
- * Commitment to excel
- * Teamwork
- * Trust and respect for the individual
- * Continuous improvement

Old Attitudes Must Die: A Classless Society

Saturn's operation today reflects the groundwork laid in the early days of concept development. Saturn's work force has developed as a classless society where everyone dresses alike. They eat together and upper management doesn't occupy plush offices.¹⁹

The workers are driven by quality and share in the successes and failures together. The atmosphere is healthy and the feeling by employees is that their personal lives are improved.²⁰ The concept is a departure from old industry attitudes.²¹

SITE SELECTION

THE PROCESS

GM announced their plan for a site search for the new Saturn facility January 9, 1985.²² Previous GM plant locations had always been conducted behind closed doors.²³ In the case of this site selection the process was done in public. It started as a bidding war between politicians and business men intent on landing 6000 jobs and the \$5 billion project in their state.²⁴ Illinois offered financial assistance, cheap real estate and even tax breaks as incentives.²⁵ There was an organized letter writing campaign organized in Iowa where school kids sent letters to GM asking for consideration.²⁶ Governors of several states even resorted to the '92 presidential campaign tactic of appearing on TV talk shows to advertise their package to GM.²⁷ Another tactic used was the purchase of billboard advertisements in Detroit. This was intended to draw attention to certain areas for consideration.²⁸ Tennessee played the game low key. They didn't send politicians to Detroit or buy billboard space.²⁹

During the bidding war GM claimed that this was not what they wanted. Not everyone believed GM. GM even attempted to downplay the importance of economic aid. Roger Smith publicly stated that GM was interested in community stability and quality schools for their employees more than economic aid.³⁰ It is interesting to note that Japanese car companies building plants

in the U.S. have used the public bidding technique to their advantage in the past.³¹ Honda, Mazda and Nissan all received generous economic packages for their site selections.³²

SITE SELECTION ANNOUNCEMENT

Finally in August 1985, several months behind schedule, GM announced Spring Hill, Tennessee as the winner of the contest.³³ Those who had so vigorously pursued Saturn missed the mark. GM used factors across the spectrum to make their final decision rather than limiting the selection to the more tangible economic benefits. Saturn Corporation released it's rationale for the Spring Hill decision. The list revealed the way Saturn intended to conduct it's business in the future.

REASON FOR SPRING HILL SELECTION

After the site selection announcement, Tennessee Governor Lamar Alexander stated, "this is a national verdict establishing Tennessee as the best environment in America in which to build the highest quality cars at the lowest price."³⁴ In a document obtained from Saturn Corporation the reasons for selecting Spring Hill are listed. The following is a synopsis of that document.

Why Tennessee?³⁵

INFRASTRUCTURE - Good highway structure with access to three interstate highways (I40, I65, I24), and excellent rail access through the CSX rail line on the western boundary of Saturn

property.

UTILITIES - Easy and inexpensive access to electricity, sewer, water and natural gas.

AVAILABLE LAND - Purchased 2450 acres of land for the plant facilities.

CENTRAL LOCATION - Spring Hill is within 600 miles of 65% of the nation's population.

FAVORABLE BUSINESS CLIMATE - Middle Tennessee was interested in expanding their industrial base. They were willing to provide tax incentives and help with building infrastructure. Tennessee provided \$30 million for a 4-lane access parkway to I65. The state also provided \$22 million for training programs for Saturn people. Maury County gave a 40-year in-lieu-of-tax agreement to provide funds for community growth. This was a two way street-- Saturn paid \$1.25 million for a new Spring Hill city hall and donated 50 acres of property for a new high school.

AVAILABLE SERVICES - Good schools and medical care nearby. Also general services such as shopping malls on hand.

VARIETY OF LIFESTYLES - City living (nearby Nashville) and a rural lifestyle available.

PHYSICAL CONDITIONS - Good climate for materials shipment and comfortable for employees. Topography was advantageous for plant construction. Rolling terrain allowed Saturn to hide facility from main highway and live up to promises made to the community not to disturb the rural aesthetics of the area.

LOCAL PERSPECTIVE

All was not roses with the selection of Spring Hill. Not all who lived in the area supported GM's decision to locate Saturn Corporation in Middle Tennessee. Two main issues surfaced as a result of Saturn's new plant. The first problem surfaced as a result of Saturn's hiring practices. Even though Saturn had publicly said they would hire many from the local population in reality hired mostly imported workers from GM.³⁶ They imported 3300 for the first 4000 jobs at Saturn.³⁷ This practice caused resentment by the local population. Additionally the schools became overcrowded with Saturn kids.³⁸ Saturn worked hard to defuse the tension by building a new city hall and donating 50 acres of land for a new high school.³⁹

ORGANIZATIONAL STRUCTURE AND LEADERSHIP

The leadership of Saturn from the beginning days consisted of individuals from GM. In the early days (82-85) most of the top leadership came from technical disciplines such as future product design, manufacturing and design engineering.⁴⁰ From

June 1982 until January 1985, the man in charge of the Saturn project was Robert J. Eaton. Mr. Eaton's title was Vice President in charge of Advanced Product and Manufacturing.⁴¹ During a press announcement in January 1985, Roger Smith, GM's Chairman heaped praise on a group of men who had led the Saturn Project to that point. It was a milestone of sorts. In the press announcement Roger Smith also announced the establishment of Saturn Corporation.⁴² Smith said Saturn Corporation, "would be an independent wholly owned subsidiary with an initial capitalization of \$150 million."⁴³ This was a departure from GM's normal mode of operation. In the past GM had it's different car lines, Pontiac, Buick, Oldsmobile and Chevrolet, as divisions under GM. According to Smith, Saturn's charge was to, "build a new car in a highly integrated manufacturing and assembly complex."⁴⁴ Additionally Saturn would use new technology in both product as well as the process of building automobiles.⁴⁵ The Saturn charge from Smith was to also adopt the "zero inventory philosophy" used by the Japanese car makers.⁴⁶

WHO WILL LEAD THIS NEW SATURN CORPORATION?

Along with the announcement of the formation of Saturn Corporation came the public release of who would lead Saturn into a reality. The following is a list of the top leadership as appointed by Chairman Roger Smith and the GM Board of Directors.⁴⁷

President - Joe Sanchez, age 54, formally the Vice President and General Manager of Oldsmobile Division.

Executive Vice President for Strategic Business Planning - Reid Rundell, age 51, formally the Executive Director of the Saturn Project.

Vice President for Sales, Service and Marketing - John Middlebrook, age 43, formally the Assistant Sales Manager for merchandising and Operations, Pontiac Motor Division.

Vice President for Finance - Tom Manoff, age 47, formally Comptroller of Delco Moraine Division.

Vice President for Engineering - Jay Wetzel, age 45, formally GM's Director of Advanced Vehicle Engineering.

Vice President for Manufacturing and Operations - Guy Briggs, age 47, formally a GM manufacturing manager.

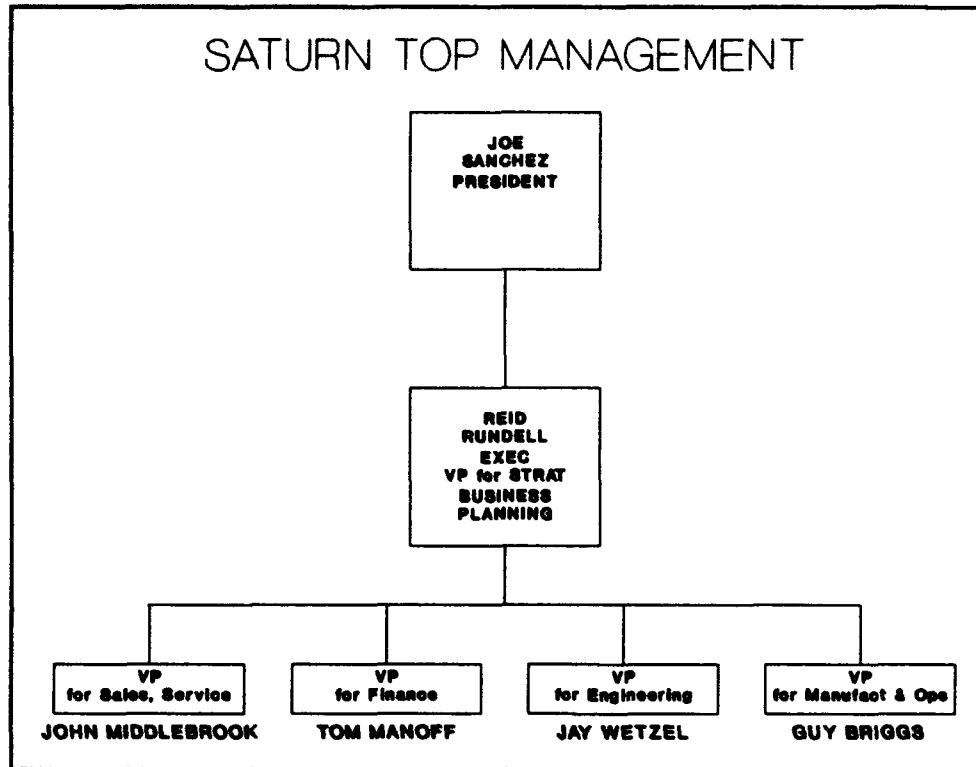


Figure 1: Saturn Corporations Top Leadership⁴⁸

Short Term as President

Just three weeks after being named President of Saturn Corporation, Joe Sanchez died.⁴⁹ William E. Hoglund replaced Sanchez and carried Saturn Corporation through the site selection process.⁵⁰ In February 1986 still another president was named. Richard E. LeFauve remains as the Saturn President today.⁵¹

ORGANIZATIONAL STRUCTURE, A NEW LOOK

The organizational structure of Saturn Corporation is dramatically different from the structures used by U.S. auto makers previously. The structure is so different that it cannot

be shown on the typical line and box organizational charts.⁵² The Saturn organizational was described by Richard LeFauve, President of Saturn, in a MIT Management article, using circles within circles.⁵³

Work Unit Module

The lowest level in the organizational structure is the work unit module. It includes those work units which require some contact with each other to perform their jobs.⁵⁴ All of the work units are located in the center of the circle. On the outer ring of the circle are charter team members, the UAW representative and the work unit module advisor. This outer circle is referred to as the "decision circle."⁵⁵ The members of the "decision circle" work new ideas for cost reduction and quality improvements. Each work unit advisor oversees four to six work unit teams. The UAW representative and the work unit advisor link the work unit module to the next level up. That next level is the business team. Figure 2 offers a pictorial view of the work unit module.⁵⁶

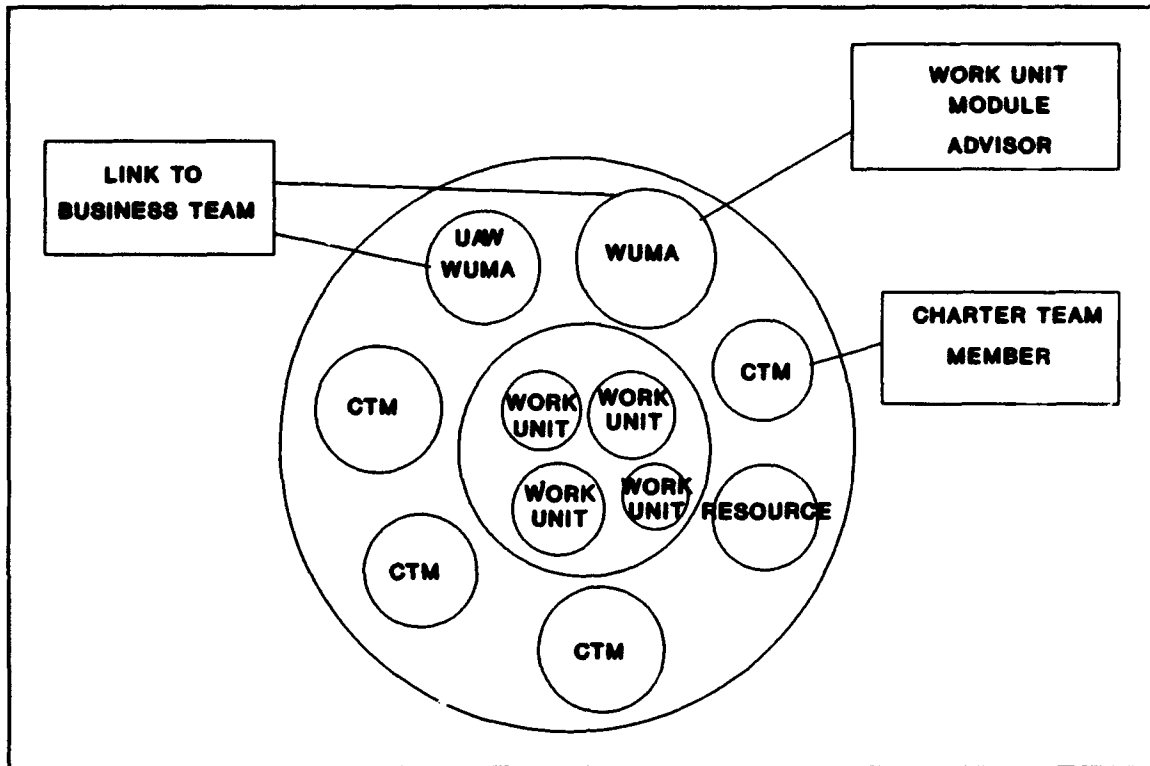


Figure 2: Work Unit Module⁵⁷

Business Unit⁵⁸

The next level in the Saturn organizational structure is the business unit. Within Saturn there are three different business units which are aligned functionally. The three units are powertrain, body systems and vehicle systems. In the center of the circle are all of the work units assigned to a particular business unit. The outer circle is made up of various leaders in various areas of responsibility as well as the UAW business team advisor and business team leader. For brevity sake not all areas of responsibility are depicted in the outer ring of figure 3.

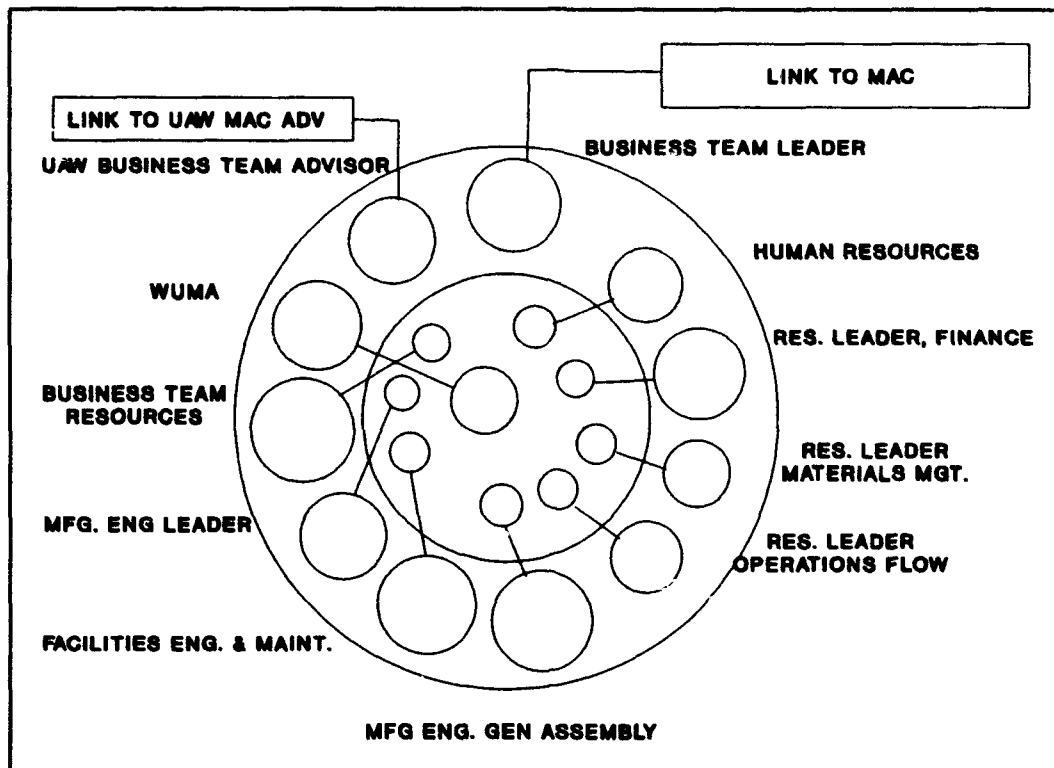


Figure 3: Business Team⁵⁹

Manufacturing Action Council⁶⁰

Each of the three business teams are subordinate to the Manufacturing Action Council (MAC). There are two other councils at this level in the structure. They are the Technical Development Action Council (TDAC) and the Customer Action Council (CAC). The TDAC handles advanced engineering and design while the CAC works customer sales, service and all marketing aspects. Again as in other levels the UAW works along side of Saturn's advisors. It is significant that Saturn and the union share in decision making. This eliminates much of the adversarial

relationship between union and management which has existed in the auto industry for years. Figure 4 illustrates the structure and makeup of the MAC. The next level in the Saturn structure is the Strategic Action Council (SAC).

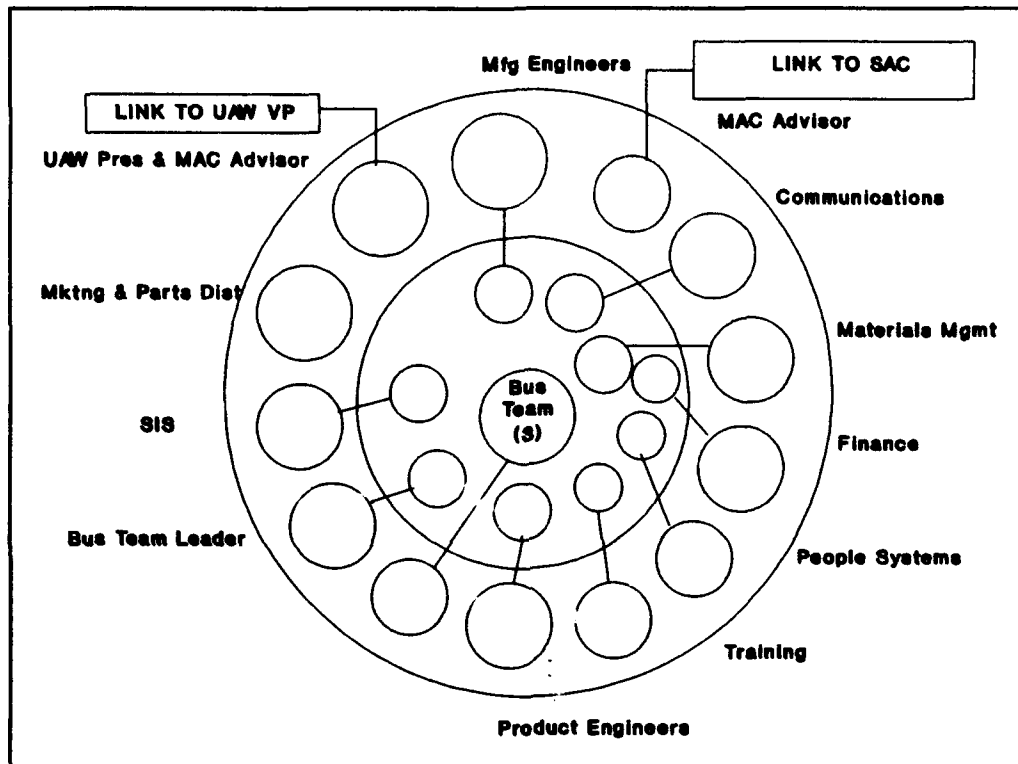


Figure 4: Manufacturing Action Council⁶¹

Strategic Action Council⁶²

The Strategic Action council is where the top level comes together. It is made up of the MAC, TDAC and CAC along with various resource teams. It is at this level that all strategic decisions are made in the Saturn Corporation. The resource teams provide professional help to each of the business teams and

assist in the decision process. The resource teams don't operate as centralized entities but as flexible teams. The chart in figure 5 is representative of the SAC.

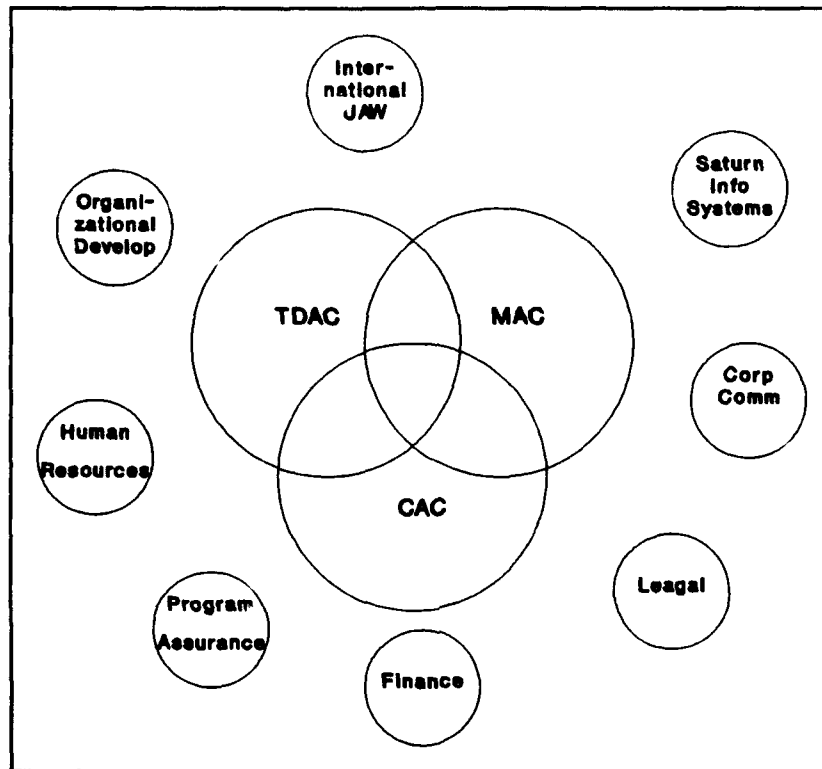


Figure 5: Strategic Action Council⁶³

MANUFACTURING PROCESS

LET'S BUILD A CAR

The production flow at Saturn takes full advantage of vertical integration. This means that a good portion of the component parts that go into the production of the final product

are manufactured under the same roof at the same facility.⁶⁴ At Saturn almost one third of the components used in the final product are produced at the Spring Hill facility.⁶⁵ Vertical integration isn't widespread in other GM products.⁶⁶

THE PLANT

The production process takes place in four separate buildings joined together under one roof.⁶⁷ The Saturn complex is housed in a four million square foot facility.⁶⁸ Simultaneous work takes place in several different work centers.⁶⁹ These three major work centers are called powertrain, body and vehicle systems.⁷⁰

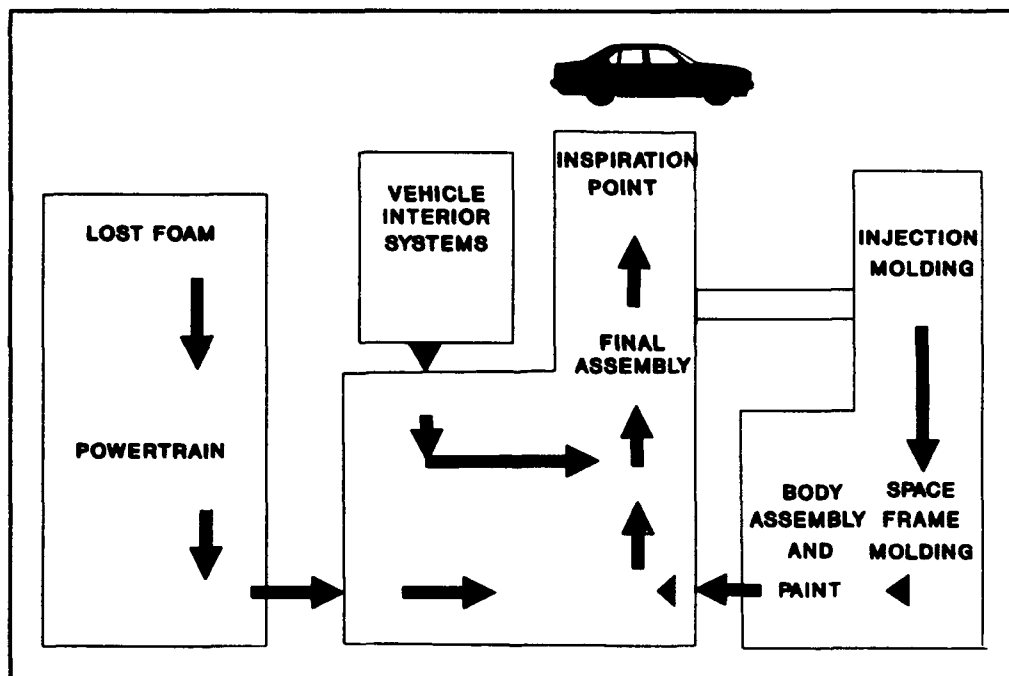


Figure 6: Manufacturing Flow⁷¹

POWERTRAIN SYSTEMS

The powertrain systems team members produce engines and transmissions for the various Saturn models. Two versions of the Saturn's 1.9 liter engine are built.⁷² Both engines use a combination of aluminum and iron components in the engine construction.⁷³ The engine block, crankshaft and heads all take advantage of a new process called "lost foam casting."⁷⁴ The lost foam process will be covered in greater detail in the technology section.

The powertrain team also builds automatic and manual transmissions on the same assembly line.⁷⁵ This is a first for any transmission assembly line.⁷⁶ The transmission team takes full advantage of flexible manufacturing equipment.⁷⁷ This allows Saturn flexibility in filling customer orders for either transmission as well as the ability to quickly change the product.⁷⁸

BODY SYSTEMS

Space Frame and Panels

While the engines and transmissions are being built the body systems team build the space frame and outer skin of the car.⁷⁹ The technology for producing the space frame was taken from the now defunct Fierro made by Pontiac Motor Division.⁸⁰ Vast improvements were made in the frame used by Fierro for the Saturn car.⁸¹ According to Dan Juliette, Saturn Director of

Manufacturing Engineering, "We've learned an awful lot about metal accuracy since the Fierro and we'll be building very, very accurate space frames."⁸² The space frame is fabricated from metal stampings and delivered to another team who produces the steel and plastic panels for the car.⁸³ Injection molding of these panels will be discussed in the next section. The panels are installed on the space frame and moved by conveyor to the paint shop where the paint is applied.⁸⁴ Saturn uses a process called waterborne paint process which is described briefly in the section that follows on Technology. The panels are then shipped as a set to the vehicle systems team.

At this point the car is placed on a skillet conveyor.⁸⁵ The skillet is a hydraulic lift platform which allows the worker to adjust the car to his own comfort zone. This reduces neck and back strain. The birch plywood surfaces cushion team members' legs because it is softer than metal surfaces.⁸⁶ The worker rides the skillet platform while he or she performs the task assigned.⁸⁷ Riding the skillet does several things. First it allows the worker to do the job without rushing. This means that less tasks go unfinished. In a traditional assembly line, sometimes if a worker runs out of time they either chase the car down the line, stop the assembly line or the car is completed with a screw missing or something similar. Many times this is latter discovered by the customer and leads to dissatisfaction with the quality of the product.⁸⁸ It also allows multiple

workers to ride and work simultaneously.⁸⁹ This more relaxed approach improves productivity because more cars can be worked simultaneously with the skillet system.⁹⁰ The skillet system is a prime example of how Saturn blends technology with people.⁹¹

Cockpit Installation

The next step in the assembly process is cockpit installation.⁹² It is here that the car gets its dash panel, instrument panel, steering column, brake and clutch and heating and air conditioning ducts.⁹³ The cockpit, like many other components is preassembled on a rotating fixture to allow the worker easy access.⁹⁴ It is then passed through the windshield opening and fastened to the space frame.⁹⁵

Body Joins Powertrain⁹⁶

The body moves now into the powertrain systems area where the engine, transmission, fluid lines and rear axle are installed. This is done using hydraulic lifts to position the entire chassis in place. All the work here is done at eye level. It is not only comfortable to the workers but allows them to see all the critical fits again improving quality. The partially assembled vehicle now leaves the floor on the skillet and travels overhead to the next line. This serves two purposes: 1) keeps aisles clear for material deliveries; 2) allows easy movement by workers.

VEHICLE SYSTEMS

Seat Installation⁹⁷

The seats for Saturn automobiles are assembled by a local supplier and delivered to the plant just before they are installed in the car. This is just one example of "just-in-time" inventory management widely used at the Saturn plant. Special attention is paid by team members to quality fit and finish items such as seats. This is an area that customers notice most in an automobile and must be an area where quality is particularly important. Each team member is charged with the responsibility of insuring quality throughout the assembly process.

Door Buildup and Exterior Panels⁹⁸

Earlier in the process, doors were removed and sent to the final skillet line. Here they get glass, interior trim, door locks, mirror controls and other parts. The doors are placed again on the space frame and finally the exterior door panels, fenders, quarter panels and bumpers are installed. This is done last to preclude damage to the painted surfaces on the assembly line. The product now looks like an automobile and moves to the final point on the line.

Arrival at Inspiration Point⁹⁹

Inspiration Point is the place where the car passes from Saturn to the hands of the customer. Fuel and fluids are loaded.

Headlights and wheels are aligned and the car is started and dynamometer tested. The car is finally driven off the line ready for shipment to Saturn dealers and ultimately the customer.

TECHNOLOGY IN THE SATURN CAR

One of the important aspects of the Saturn story is a discussion of the technology used at Saturn. Some of the more prominent technologies used are: lost foam casting, waterborne paint, polymer plastic injection molding, robotics and centralized computer control systems. Each of these will be discussed in this section of the case study.

LOST FOAM¹⁰⁰

Saturn spent many years investigating engine design and manufacturing technology. One of the results of these investigations was the development and incorporation of lost foam die casting. It is a state-of-the-art technology for making engine blocks, crankshafts and cylinder heads. Lost foam technology is done by producing a polystyrene (same material used in disposable coffee cups) copy of whatever part is to be manufactured. The copy is placed in a mold and molten metal is poured into the mold. The hot metal vaporizes the polystyrene and the part comes out as a finely finished part which requires no machining or processing. The whole process is quick, accurate

and less costly than previous processes. There is no doubt that lost foam casting has a place in engine manufacturing. Other auto makers are now looking at this process as an alternative to the traditional method of engine manufacturing.

WATERBORNE PAINT¹⁰¹

Saturn cars are painted with waterborne paint. The process leaves a deep rich finish which is very durable and pleasing to the eye. The paint is applied by robot thus yielding the same uniform quality on each car on the assembly line. The finish on the Saturn car is one of the best in the industry from an aesthetic and durability perspective.

POLYMER PLASTIC INJECTION MOLDING

Exterior door and side panels on the Saturn car are constructed with polymer plastic using a process called injection molding.¹⁰² Saturn uses 12 - 5,000 ton and 12 - 3,125 ton injection molders to make the plastic panels.¹⁰³ Salesmen at Saturn dealerships demonstrate the durability of these door panels by inviting the potential customer to jump up and down on a sample door panel.¹⁰⁴ This demonstrates the flexibility of the panels and durability of the waterborne paint used on the panels.

ROBOTICS

Robotics, while not new to the auto industry, are widely used in Saturn's manufacturing of automobiles. About 300

robots manufactured by GMFANUC Robotics Corporation, a joint venture between GM and Japanese owned FANUC LTD are used.¹⁰⁵ The robots are used successfully to perform a range of tasks from welding to painting. One advantage of using robots for such tasks is consistency. Let's say for example 37 welds are required. A robot will make all 37 welds every time, whereas a human may occasionally miss a weld or two.¹⁰⁶ Another reason, perhaps more important is that robots can perform difficult and unpleasant tasks.¹⁰⁷

CENTRALIZED COMPUTER SYSTEMS

Saturn's use of computer systems for monitoring and dispatching is impressive. The entire manufacturing process is monitored by a centralized computer center located on the floor of the assembly building.¹⁰⁸ It is used to detect problems on the line and dispatch maintenance personnel when needed.¹⁰⁹ Saturn dealerships are linked to the computer system for ordering cars for customers.¹¹⁰ The dealer can also monitor the production of a customer's order and even change the order up to when assembly begins.¹¹¹

QUALITY CONTROL¹¹²

Saturn competes in a market where Honda, Toyota and others have established quality as a given. One of the key strategies adopted by Saturn early on was to meet or exceed customer

expectations in quality. To do this Saturn took a little different approach from traditional quality control methods.

Saturn does not have a formal Quality Control Department. It doesn't have any single person in charge of quality. They use a series of Quality Councils. These Quality Councils provide goals and general standards of quality. Each council is made up of a team consisting of both union and management members. At the top of the Saturn quality structure is a Quality Council chaired by the President of Saturn's Local UAW and the President of Saturn Corporation. Other councils are at all levels and include union and management. Additionally, Saturn uses specific quality resource areas to help teams on the manufacturing floor.

METHODS OF MONITORING

Monitoring the product quality takes place through the following:

- * Use of statistical methods.
- * Adherence to Quality Systems and established procedures.
- * Use of quality tools such as Pareto Analysis, Cause and Effect Diagrams, pictographs and others.
- * Education in problem solving techniques.
- * Inherent team motivation and enthusiasm (no shortage of this at Saturn).

Saturn also relies on customer feedback. Information from

the field arrives at Saturn within 25 hours, where analysis and corrective action takes place. Additionally Saturn uses data from J.D. Powers AND Associates (an internally generated customer satisfaction comparison), to see how they stack up against the competition in their market. Some measures of Saturn's success in the quality arena can be seen in the next section.

BUILDING THE FIRST DELIVERABLE CARS

Saturn began building cars in July 1990, eight years after the beginning of the Saturn project.¹¹³ However, Saturn sales were not launched until October 1990.¹¹⁴ The delay was in large part due to Saturn's insistence on quality standards.

EARLY PROBLEMS WITH QUALITY

Workers and engineers found many problems when they first started producing cars.¹¹⁵ This was especially true in their base model SL sedan. Engine vibrations in the automatic transmission equipped SL caused engineers to redesign the engine mounts.¹¹⁶ This redesign delayed SL production by five months.¹¹⁷ Saturn also lost 3 weeks of production time on the manual transmission version of the SL due to a change in supplier of the shifting mechanism.¹¹⁸ Saturn had a series of supplier parts problems but held the suppliers to quality standards. The just-in-time inventory management worked as it was intended. Problems were identified and production was halted until the

problem could be fixed.¹¹⁹ Additionally, Saturn discovered that the learning curve for workers was slower than forecast.¹²⁰ The task of workers inspecting their own work was new to the workers and required more time to learn than originally expected.¹²¹

QUALITY A MUST

Most of the delays experienced can be traced to Saturn's goal of building a world class quality automobile. They needed to get it right from the start or there might not be a finish. All of the delays were important to building a quality reputation.¹²² A south Florida dealer said it best with, "I'd rather be slim on cars than have cars that aren't up to what the customer expects."¹²³

RECALLS WORKED TO SATURN'S ADVANTAGE

Saturn had two major recalls in the early months of production and delivery of cars. The first recall occurred in February 1991, with 1,210 cars (30% of those sold).¹²⁴ Owners were pampered by repair crews who fixed front seatbacks that could slip backwards uncommanded.¹²⁵ Saturn seemed unhurt from this and turned the problem into a commercial. The commercial shows a Spring Hill Saturn employee traveling to remote Alaska, new seat in hand, and fixing the car for a customer on site. This tactic was good advertisement since it showed Saturn's commitment to service and quality. Saturn did well by turning a potential problem into a strong point.

Early Trade-In For Some

A second major recall took place in May 1991.¹²⁶ Saturn recalled 1,836 cars and replaced them with new cars as a result of improperly mixed anti-freeze.¹²⁷ Texaco had accidentally incorrectly mixed the anti-freeze.¹²⁸ The bad coolant could cause damage to engine, radiator, water pump and the heater core.¹²⁹ Saturn's decision to replace the cars proved to be a major factor in customer satisfaction with Saturn in the future.

PRODUCTION

Delays in production led to a backlog of orders. By April 1991 Saturn was producing 300 cars per day.¹³⁰ In May 1991 they added a second shift and boosted production to 800 cars per day by August.¹³¹ From there they gained steam and produced 12,258 cars in September.¹³² By March of 1992 Saturn had attained full speed in production with nearly 20,000 cars per month coming off the assembly line.¹³³

MARKETING THE PRODUCT

ADVERTISING STRATEGY

Saturn's approach to selection of an advertising strategy was much like their approach to other aspects of the development of Saturn. They took a clean sheet approach and looked at what had worked for others. To start with, they incorporated a UAW official and a dealer on a panel to select an ad agency.¹³⁴ In

their search they wanted to break to "old boy network" of Detroit based ad agencies.¹³⁵ By April of 1988 the search had narrowed to three potential agencies.¹³⁶ In May 88, the Hal Riney and Partners of San Francisco was selected.¹³⁷

In the beginning of the ad campaign Saturn concentrated on selling the image of a new company with new approaches. It used a humanistic approach, telling the story about the building of Saturn in rural Tennessee. This was done to make people aware of Saturn as opposed to the actual car. In October 1990, after car sales began they shifted to showing the car more.¹³⁸ The strategy worked. Even before cars went on sale about 200 people per day were looking at displays of the Saturn car at a Warren Michigan dealership.¹³⁹ In late 1990 much of the knowledge about Saturn was attributed to not only the ad campaign but to news reports about Saturn.¹⁴⁰

Saturn strategy included a dependence on Saturn buyers passing on the word about Saturn.¹⁴¹ They also incorporated this into some of their commercials. They used examples of customers who had a story to tell about their Saturn experience. Most dealers were pleased with Saturn's campaign.¹⁴² After all they were selling all the cars they could get their hands on. Geoff Pohanka, owner of three Washington D.C. area dealerships, said, "Saturn's advertising is in line with the ideals and goals of Saturn," he went on to say, "Saturn has a pretty good story to

tell, about a company that is a very humanistic endeavor to try to do things right the first time."¹⁴³

DEALERSHIP SELECTION

Money Talks

Saturn's dealer selection was a stringent process. To start with, a potential dealer needed a net worth of \$1.3 million.¹⁴⁴ They had to submit personal financial records, access to banking information, provide details on personal liquidity and provide detailed reports on stocks and bonds ownership.¹⁴⁵ To become a Saturn dealer also took a significant investment. To become a dealer the investment included \$2,500 for a market survey, \$50,000-\$150,000 for design fees and whatever the building and land cost.¹⁴⁶ Before the public ever saw the car the investment could total as much as \$15 million.

Strict Control

Saturn also levied stringent facilities design demands and were inflexible on site selection.¹⁴⁷ Dealers also had to agree to Saturn standards and code in all aspects of the business.¹⁴⁸ It is no surprise that Saturn's dealer selection got off to a rocky start. Several potential dealers dropped out because of cost and stringent Saturn requirements.¹⁴⁹

Investment Pays Off

Even with the problems, Saturn managed to have 126

dealerships by October '91, and 250 by late '92.¹⁵⁰ They project 800 dealerships in the next few years.¹⁵¹ By June '91, 70% of the dealerships were profitable, in spite of the large initial investment.¹⁵²

PRODUCT LINE¹⁵³

The Saturn line of automobiles is not limited to one particular model. They start with a base model sedan, the SL sedan. It is a no frills, four door sedan with limited available options. Options include air conditioning, automatic braking system and various choices of radio equipment. Next up the line is the SL1 and SL2 sport sedan which offers a slightly wider range of options such as cruise control, power windows, locks and mirrors, sunroof, spoiler, traction control, alloy wheels and fog lamps. Also available on the SL2 is leather interior. Saturn has a station wagon version of the sport sedan called the SW1 and SW2. Finally, Saturn offers the sport coupe in the SC1 and SC2. The sport coupe has the full range of options available.

COMPETITION BEWARE

Saturn's target market includes import owners, predominately young and well educated.¹⁵⁴ The competition for the sedan and sport sedan is the Honda Civic, Toyota Corolla, Mazda Protege and Nissan Sentra.¹⁵⁵ Saturn's sport coupe competes with Mitsubishi Eclipse, Toyota Celica, Mazda MX-6 and the Nissan 240SX.¹⁵⁶ Saturn used various positive qualities of the import competition

when designing their cars. The Saturn incorporates the firm ride and handling like the Mitsubishi, engine response like the Mazda, body design like the Nissan and controls and passenger comfort like the Honda.¹⁵⁷

Penetrating the Import Market

According to a Saturn dealership in Northern Virginia they are selling about 78% to former import owners.¹⁵⁸ This is good news for GM since it is considered a new market as opposed to taking market share from GM's existing market share.

PRICING STRATEGY

Saturn offered it's SL sedan at a surprisingly low \$7,995 base price for it's '91 model car.¹⁵⁹ This low price strategy pleased Saturn dealers. It gave them a good start to enter the market. The median transaction price for all Saturns sold through October '91 was \$12,200.¹⁶⁰ Saturn uses a no negotiation price strategy in selling it's cars. What you see on the sticker is what you pay. This strategy has worked since the cars are reasonably priced on the sticker, unlike other cars which have high markup on the sticker built-in for negotiating. Other car dealers are beginning to look at this strategy for their use. One other unique strategy that Saturn used in 1991 was an offer to refund a customer's money if he or she was unhappy within 30 days or 1,500 miles. This was offered to overcome the reluctance to try a brand new model that hasn't been tested in the real

world.

PRICE INCREASE

When Saturn introduced it's '92 models, they also announced a price increase, on average 4.7%. Increases were also applied to options. They hiked the price again with the introduction of '93 year models. The following price list is provided to show a comparison of '91, '92 and '93 year base prices for a car equipped with manual transmission.¹⁶¹

	91	92	93
SL	\$7,995	\$8,195	\$9,125
SL1	\$8,595	\$8,995	\$9,995
SL2	\$10,295	\$10,395	\$11,495
SC1	N/A	N/A	\$10,995
SC2	\$11,775	\$11,875	\$12,795
SW1	N/A	N/A	\$10,895
SW2	N/A	N/A	\$12,195

INVENTORIES

When Saturn was first introduced for customer sales, there was a very small inventory. Customer orders quickly backed up.

This back log of orders was further complicated by delays on the production line as Saturn tried to solve quality problems.¹⁶² Customers had to wait four to six weeks for their cars. In September 1992, Saturn of Fredericksburg had a few models available for sale. If a customer wanted a model not in the inventory, the delivery date was approximately 30 days.¹⁶³ By February 1993 ads in the Washington Post, indicated a plentiful inventory for customers to choose from.

EVALUATION OF SATURN CARS

SALES

Sales of the Saturn have been brisk from the very beginning. In September 1991, less than one year after introduction Saturn climbed to the top spot in sales per dealer among U.S. car dealers.¹⁶⁴ They sold an average 67 cars per dealer to win the number one spot.¹⁶⁵ Other cars placing in the top ten, in order are: #2 Honda, #3 Toyota, #4 Nissan, #5 Ford, #6 Lexus, #7 Chevrolet, #8 Acura, #9 Infiniti, and #10 Mazda.¹⁶⁶ The number of sales per dealer steadily increased and in April 1992, Saturn averaged 110 cars per dealer in the U.S. and 25 cars per dealer in Canada.¹⁶⁷ Sales figures for 1992 through September are provided in the following chart.

SATURN SALES FOR 1992¹⁶⁸

JANUARY	10,204
FEBRUARY	13,035
MARCH	16,757
APRIL	16,345
MAY	18,031
JUNE	21,038
JULY	22,305
AUGUST	12,038
SEPTEMBER	15,187

Market Share

Saturn's market share of U.S. auto sales rose from .8 in 1991 to 2.3 in 1992.¹⁶⁹ They increased from 48,938 units sold in '91, to 144,940 units in '92.¹⁷⁰ While Saturn 's market share increased, two of it's foreign competitors' shares dropped.¹⁷¹ Saturn's goal was to take plus business (from imports and other domestics).¹⁷² In the first year Saturn claimed 67% plus business, exceeding the goal by 2%.¹⁷³ Ongoing surveys indicate 49% Saturn buyers are would be import buyers and 18% would be other domestic buyers.¹⁷⁴

CONSUMER SATISFACTION

The automotive industry uses an internal organization to do surveys of car buyers to measure satisfaction. The firm that does this is J.D. Powers & Associates. In the Powers Initial Quality Survey dated February 1992, Saturn fared well in several important categories. Saturn placed second behind Lexus and ahead of Infiniti, in the Dealers Satisfaction Index.¹⁷⁵ In the Sales Satisfaction category Saturn finished sixth behind Lexus, Cadillac, Infiniti, Lincoln and Mercedes Benz, all luxury cars which cost thousands more than the Saturn.¹⁷⁶ When compared to small cars in the same market, Saturn ranked number 1 out of 24 in Overall Ownership Experience and Retail Satisfaction.¹⁷⁷

QUALITY AND PERFORMANCE

As previously noted, Saturn's commitment to quality is undisputed. Owners of Saturn cars are satisfied with the product. Return rates for repairs are low.¹⁷⁸ Owners and potential customers are aware that Saturn will stand behind their product as a result of the bad coolant recall and replacement deal.

The early cars produced by Saturn drew some criticism but Saturn listened to these criticisms and fixed the problems. Industry analysts and journalist who test-drove the early Saturns noted several problems with the car and characterized it as meeting the competition but not beating it.¹⁷⁹ In October 1990,

Saturn officials admitted their cars had no overall superiority to the products of Honda, Nissan and Toyota.¹⁸⁰ On the positive side, test drivers gave the car good ratings for handling, seat comfort and under the hood component arrangement.¹⁸¹ Negative comments were made about wind noise, engine vibrations and sluggish engine performance (limited to the 85 horsepower single overhead cam version).¹⁸² Saturn took these comments and worked out the problems. The '93 models are much improved from the original cars.¹⁸³ Saturn officials no longer make statements about superiority such as the one made in October 1990.

CONCLUSION

The Saturn Corporation took eight years and a huge capital investment to build their car. They started with a clean sheet of paper. They investigated the automobile industry, both domestic and foreign, for ideas on what worked best for others. They took the best of these ideas, expanded and refined them and put together a corporation building world class competitive small cars. They accomplished their goal.

Saturn incorporated the Deming philosophies into their process and became a car maker where the union shares decision making with management. They have successfully incorporated features of competitiveness for the 1990's and beyond. Among the standout features are: just-in-time production, cycle time

reduction, total quality management, flattened hierarchy, computer-integrated manufacturing, flexible manufacturing systems and much more.

Saturn has created more than a car company. They have created a team culture in Spring Hill Tennessee. It is a classless society where employees dress alike, eat together, and most importantly work together. New ideas and better ways of doing things are not only listened to, but expected. Saturn is a unique blend of people and technology.

The data to date indicates that Saturn is a success. They are etching away at market shares previously held by import auto makers. Customers are happy with the product and sales are booming. The Saturn facility has now reached full production capacity at 240,000 cars per year.

Other industries could learn from the Saturn Corporation. Certainly GM is taking what they have learned from their Saturn investment and incorporating it into their existing plants and facilities where practical. It will not be an overnight experience. Like Saturn, it will take time, investment and a strong commitment to regain the role of world leader in the automobile industry.

ENDNOTES

1. Information in this paragraph taken from a commercial video produced for and distributed by Saturn Corporation. "Spring In Spring Hill." Saturn Corporation Media Center, Spring Hill, Tennessee.
2. "Important Dates in Saturn History," unpublished Saturn Corporation employee training materials, undated, p. 1.
3. This is the approach taken in the early days by a group of 99 GM employees assembled to develop Saturn's concept. Taken from video, "Spring in Spring Hill."
4. Warren Brown, "Saturn SL2: U.S. Victor," The Washington Post Weekend, April 12, 1991, p. 57.
5. Ibid, p. 57.
6. Roger B. Smith, statement by GM Chairman at news conference in Warren, Michigan, January 8, 1985.
7. Jack O'Toole and Jim Lewandowski, "Forming the Future: The Marriage of People and Technology at Saturn," unpublished paper for Stanford University Industrial Engineering and Engineering Management, March 29, 1990, p. 3.
8. Ibid, p. 3.
9. Ibid, p. 3.
10. Ibid, p. 3.
11. Ibid, p. 4.
12. "Spring in Spring Hill," Video Tape by Saturn Corporation Media Center, undated.
13. O'Toole and Lewandowski, p. 5.
14. Mary McGrory, "Enlightenment From Saturn," The Washington Post, December 1, 1992, p. A2.
15. Telephone interview with Marty Crocker, a Saturn Team Leader at Saturn Corporation in Spring Hill, Tennessee, December 1, 1992.
16. Taken from a card issued to all Saturn employees during training, undated.

17. Ibid.
18. Ibid.
19. Mary McGrory, "Enlightenment From Saturn," The Washington Post, December 1, 1992, p. A2.
20. Ibid, p. A2.
21. Ibid, p. A2.
22. Richard Brandt, "Wherever GM Puts Saturn It's Going to Get a Sweet Deal," Business Week, April 1, 1985, p. 36.
23. Ibid, p. 36.
24. Ibid, p. 36.
25. Ibid, p. 36.
26. Ibid, p. 36.
27. Ibid, p. 36.
28. Ibid, p. 36.
29. Pete Engardio and Maralyn Edid, "Why a 'Little Detroit' Could Rise in Tennessee," Business Week, August 12, 1985, p. 21.
30. Richard Brandt, "Wherever GM Puts Saturn It's Going to Get a Sweet Deal," Business Week, April 1, 1985, p. 36.
31. Ibid, p. 36.
32. Ibid, p. 36.
33. Maralyn Edid, "On a Clear Day, You Still Can't See Saturn," Business Week, August 12, 1985, p. 20.
34. Engardio and Edid, p. 21.
35. "Why Tennessee?" unpublished materials used for training new Saturn employees, undated, p. 1-5.
36. Lindsay Chappell, "Friction in Spring Hill," Automotive News, November 5, 1990, p. 1.
37. Ibid, p. 1.
38. Ibid, p. 26.

39. "Why Tennessee", p. 3.
40. Roger B. Smith, statement by GM Chairman at a news conference in Warren, Michigan, January 8, 1985, p. 2.
41. Ibid p. 2.
42. Ibid p. 2.
43. Ibid, p. 3.
44. Ibid, p. 3.
45. Ibid, p. 3.
46. Ibid, p. 3.
47. Ibid, p. 2.
48. Ibid, p. 2.
49. John K. Teahen Jr., "The Birth of Saturn," Automotive News Insight, December 31, 1990, pp. 4i-8i.
50. Ibid, p. 4i.
51. Ibid, p. 4i.
52. Richard G. LeFauve and Arnolddo C. Hax, "Managerial and Technological Innovations at Saturn Corporation," MIT Management, Spring 1992, p. 13.
53. Ibid, p. 13.
54. Ibid, p. 13.
55. Ibid, p. 13.
56. Ibid, p. 12.
57. Ibid, p. 12.
58. Ibid, p. 13, all information in this paragraph taken from the LeFauve and Hax article.
59. Ibid, p. 13.
60. Ibid, p. 13-14, all information in this paragraph comes from the LeFauve and Hax article.
61. Ibid, p. 14.

62. Ibid, p. 14-15, this paragraph also comes from the same article.
63. Ibid, p. 15.
64. Lindsay Chappell, "Another World", Automotive News Insight, September 24, 1990, p. 18i.
65. Lindsay Chappell, "Saturn Lifts Veil on Assembly Plant, Cars Arrive in October," Automotive News, September 24, 1990, p. 4.
66. Ibid, p. 4.
67. Lindsay Chappell, "Another World," Automotive News Insight, September 24, 1990, p. 14i.
68. Ibid, p. 14i.
69. Ibid, p. 14i.
70. Richard G. LeFauve and Arnolde C. Hax, p. 13.
71. Ibid, p. 13.
72. Untitled pamphlet from Saturn Corporation used during plant tours, undated.
73. Ibid.
74. Ibid.
75. Ibid.
76. Ibid.
77. Lindsay Chappell, "Another World," p. 18i.
78. Lindsay Chappell, "Saturn Lifts the Veil on Assembly Plant, Cars Arrive in October," P. 4.
79. Plant tour pamphlet.
80. Lindsay Chappell, "Another World," p. 8i.
81. Ibid, p. 8i.
82. Ibid, p. 8i.
83. Ibid, p. 8i.
84. Plant tour pamphlet.

85. Ibid.
86. Lindsay Chappell, "Another World," p. 10i.
87. Ibid, p. 8i.
88. Ibid, p. 18i.
89. Ibid, p. 18i.
90. Ibid, p. 18i.
91. Plant tour pamphlet.
92. Ibid.
93. Ibid.
94. Ibid.
95. Ibid.
96. Powertrain information from plant tour pamphlet.
97. From plant Tour pamphlet.
98. Ibid.
99. Ibid.
100. Al Fleming, "Lost Foam Finds a Home," Automotive News Insight, April 16, 1990, p. 32i.
101. Plant tour pamphlet.
102. Lindsay Chappell, "Another World," p. 18i.
103. Ibid, p. 18i.
104. Interview with Mark Toczka, a Saturn salesman at Saturn of Fredericksburg, Virginia, September 1992.
105. David Whiteside, Richard Brandt, Zachary Schiller and Andrea Gabor, "How GM's Saturn Could Run Rings Around Old-Style Carmakers," Business Week, January 28, 1985, p. 128.
106. Presentation by a historian at the Smithsonian Institute's Museum of American History, February 1993.
107. Whiteside, p. 128.
108. Plant tour pamphlet.

109. Ibid.
110. Toczka interview.
111. Ibid.
112. Information on quality control in this section taken from Quality information provided by Saturn Corporation.
113. James B. Treece, "Are the Planets at Last Lining Up for Saturn?" Business Week, April 8, 1991, p. 32.
114. Ibid, p. 32.
115. Ibid, p. 32.
116. Ibid, p. 32.
117. Ibid, p. 32.
118. Ibid, p. 32.
119. Ibid, p. 32.
120. Ibid, p. 32.
121. Ibid, p. 32.
122. Ibid,p. 34.
123. Ibid, p. 34.
124. Ibid, p. 34.
125. Ibid, p. 34.
126. Gregory Patterson, "GM's Saturn Corp. to Recall 1,836 Cars and Provide Owners With New Vehicles," The Wall Street Journal, May 13, 1991, p. B8.
127. Ibid, p. B8.
128. Ibid, p. B8.
129. Ibid, p. B8.
130. Treece, p. 34.
131. Joseph B. White, "GM's Saturn Unit to Boost Output 33% This Month," The Wall Street Journal, August 9, 1991, P. A2:4.

132. "GM Unit May Need More Time to Hit Full Production," The Wall Street Journal, October 11, 1991, p. B4:4.

133. Ibid, p. B4:4.

134. Ray Serafin and Laura Clark, "Dealer and UAW to Help Pick Saturn Ad Agency," Automotive News, March 7, 1988, p. 6.

135. Ibid, p. 6.

136. Kathleen Hamilton, "Saturn; It's on Target for '90 Intro; Lineup to Grow--LeFauve," Automotive News, April 25, 1988. p. 32.

137. John A. Russell, "Riney Agency Wins Saturn Ad Account," Automotive News, May 30, 1988, p. 3.

138. Cleveland Horton, "Saturn Teasers Start Oct. 2," Automotive News, October 1, 1990, p. 42.

139. Serafin, p. 10.

140. Ibid, p. 10.

141. Hamilton, p. 32.

142. Serafin, p. 10.

143. Ibid, p. 10.

144. Lindsay Chappell, "2 of 9 Dump Saturn Pact, Cite Expense," Automotive News, October 17, 1988, p. 4.

145. Ibid, p. 4.

146. Ibid, p. 4.

147. Ibid, p. 1.

148. Ibid, p. 1.

149. Ibid, p. 1.

150. Lindsay Chappell, "Clean Sheet for Dealer Plan," Automotive News, October 26, 1991, p. 31.

151. Ibid, p. 31.

152. Ibid, p. 31.

153. Product line information obtained from Saturn of Fredericksburg in Virginia.

154. Serafin, p. 10.
155. Horton, p. 42.
156. Ibid, p. 42.
157. Lindsay Chappell, "Saturn Guns the Engine for October Introduction," Automotive News, October 1, 1990, p. 42.
158. Interview with Mark Toczka of Saturn of Fredericksburg.
159. Chappell, "Saturn Guns the Engine for October Introduction," p. 42.
160. Phil Frame, "Scorecard Shows Saturn On Track," Automotive News, October 28, 1991, p. 3.
161. '91 and '92 prices taken from "GM's Saturn Unit to Raise Base Prices on It's 1992 Models," The Wall Street Journal, August 19, 1991, p. B8. '93 prices provided by Saturn of Fredericksburg, Virginia.
162. Treece, p. 34.
163. Interview with Mark Toczka.
164. Karen Detkowski, "Saturn Dealers Top'em in September Sales Per Outlet," Automotive News, October 14, 1991, p. 28.
165. Ibid, p. 28.
166. Ibid, p. 28.
167. Jeremy Sinek, "Saturn Success Catches Canadians by Surprise," Automotive News, June 8, 1992, p. 33.
168. "Saturn Fact Sheet," unpublished training materials used by Saturn Corp.
169. "U.S. Car and Light Truck Sales," Automotive News, October 12, 1992, p. 38.
170. Ibid, p. 38.
171. Ibid, p. 38.
172. Phil Frame, "Scorecard Shows Saturn on Track," Automotive News, October 28, 1991, p. 30.
173. Ibid, p. 30.
174. Ibid, p. 30.

175. LeFauve and Hax, p. 18.

176. Ibid, p. 18.

177. Alan G. Perrito, Director, Materials Management, Saturn Corporation in a speech to a seminar at University of Michigan, August 5, 1991.

178. According to Saturn of Fredericksburg, Virginia.

179. Warren Brown, "GM's New Subcompact Taken Out for a Spin," The Washington Post, October 9, 1990, p. C1.

180. Ibid, p. C1.

181. Ibid, p. C1.

182. Ibid, p. C1.

183. Based on the authors test-drive of a 1993 Saturn SL2 in September 1992.

SELECTED BIBLIOGRAPHY

Bennett, Michael E. "The Saturn Corporation: New Management Union Partnership at the Factory of the Future." Looking Ahead. Vol. XIII, April 1992, pp. 15, 21-23.

Bowans, Greg. "Dealers Find Ways to Cut Cost Until Sales Get up to Speed." Automotive News. July 30, 1990, p. 42.

----- "Saturn's Dealers Risk Heavenly Sums to Sell New GM Car." Automotive News. July 30, 1990, pp. 1,42.

Brandt, Richard. "Wherever GM Puts Saturn It's Going to Get a Sweet Deal." Business Week. April 1, 1985, pp. 36-37.

Breese, Kristine Stiven. "California or Bust." Automotive News. October 28, 1991, pp. 3, 30.

----- "Saturn Sales." Automotive News. October 29, 1990, pp. 1 & 51.

Briggs, Guy D. "Saturn Manufacturing I." Unpublished training materials used by Saturn Corporation. Undated.

Brown, Warren. "GM's New Subcompact Taken Out for a Spin." The Washington Post. October 9, 1990, pp. C1 & C5.

----- "Saturn SL2: U.S. Victor." The Washington Post Weekend. April 12, 1991, p. 57.

----- "Tracking Saturn Truthfully." The Washington Post Weekend. November 1, 1991, p. 62.

Brown, Warren and Swoboda, Frank. "Out With the Olds In With the New?" The Washington Post. October 28, 1992, pp. G1 & G3.

Chappell, Lindsay. "Another World." Automotive News Insight. September 24, 1990, pp. 8, 10, 14, 18.

----- "Clean Sheet for Dealer Plan." Automotive News. October 28, 1991, pp. 31-32.

----- "2 of 9 Dump Saturn Pact, Cite Expense." Automotive News. October 17, 1988, pp. 1,3-5.

----- "Friction in Spring Hill." Automotive News. November 5, 1990, pp. 1, 45.

----- "Saturn Dealers Cheer for Low-Price Strategy." Automotive

News. October 8, 1990, pp. 1, 44.

----- "Saturn Guns the Engine for October Introduction." Automotive News. October 1, 1990, pp. 1, 42.

----- "Saturn Lifts Veil on Assembly Plant, Cars Arrive in October." Automotive News. September 24, 1990, p. 4.

----- "Saturn Plans No Dickering When it Sells." Automotive news. October 8, 1990, p. 44.

----- "Super-Efficient Supplier Base Will Be Key to Saturn's Operating Philosophy." Automotive News Insight. June 11, 1990, p. 26i.

Crocker, Marty. Telephone interview with a Saturn Team Leader in Spring Hill, Tennessee. December 1, 1992.

Detkowski, Karen. "Saturn Dealers Top'em in Sept. Sales Per Outlet." Automotive News. October 14, 1991, p. 28.

Eddid, Maralyn. "A New Labor Era May Dawn at GM's Saturn." Business Week. July 22, 1985, pp. 65-66.

----- "On a Clear Day, You Still Can't See Saturn." Business Week. August 12, 1985, pp. 20-21.

----- "How Power Will be Balanced on Saturn's Shop Floor." Business Week. August 5, 1985, pp. 65-66.

Engardio, Pete and Maralyn Eddid. "Why a 'Little Detroit' Could Rise in Tennessee." Business Week. August 12, 1985, p. 21.

Fleming, Al. "Lost Foam Finds a Home." Automotive News Insight. April 16, 1990, p. 36i.

----- "Saturn VP Guy Briggs Has a Heavenly Goal." Automotive news Insight. May 14, 1990, p. 30i.

----- "A Story of Epic Proportions." Automotive News Insight. September 24, 1990, p. 32i.

Frame, Phil. "Saturn Delays Opening, May Compensate Dealers for Lack of Cars." Automotive News. December 3, 1990, pp. 1 & 45.

----- "Saturn Drives Job. 1 Today." Automotive News. July 30, 1990, pp. 1, 43.

----- "Saturn Now Tells Dealers to Wait on New Stores." Automotive News. May 4, 1992, pp. 3, 32.

----- "Saturn Plan: Only 560 Will be No-Option \$7,995 Cars."

Automotive News. November 19, 1990, pp. 1 & 44.

----- "Scorecard Shows Saturn on Track." Automotive news. October 28, 1991, pp. 3, 30.

"GM's Saturn to Compensate Dealers for Late Deliveries." The Wall Street Journal. January 8, 1992, p. A3:3.

"GM's Saturn Unit to Raise Base Prices on its 1992 Models." The Wall Street Journal. August 19, 1991, p. B8.

"GM Unit May Need More Time to Hit Full Production." The Wall Street Journal. October 11, 1991, p. B4:4.

Hamilton, Kathleen. "Richard LeFauve; The President of Saturn Corp. Discusses the Process of Launching the First Saturn Car." Automotive News. June 6, 1988, pp. E14-23.

----- "Saturn; It's on Target for '90 Intro; Lineup to Grow -- LeFauve." Automotive News. April 25, 1988, pp. 1, 32-33.

Hampton, William J. "Will Saturn Ever Leave the Launchpad?" Business Week. March 16, 1987, p. 107.

Hoerr, John and Aaron Bernstein. "The NLRB Strikes a Blow for Worker Participation." Business Week. June 16, 1986, p. 36.

"Important Dates in Saturn History." Unpublished document used in training new Saturn employees. Undated, pp. 1-9.

Keebler, Jack. "Saturn's: Good, Can Get Better." Automotive News Insight. October 22, 1990, p. 22i.

Kornheiser, Tony. "Milking the Car Market For Laughs." The Washington Post. May 5, 1991, pp. F1-F2 & F5.

LeFauve, Richard G. and Arnoldo C. Hax. "Managerial and Technological Innovations at Saturn Corporation." MIT Management. Spring 1992, pp. 8-19.

LeFauve, Richard G. "The Saturn Corporation: A Balance of People, Technology, and Business Systems." Looking Ahead. Vol. XIII, April 1992, pp. 14, 16-20.

Mandel, Dutch and Laura Clark. "Saturn; LeFauve Would Ship 1st to Tokyo as 'Symbol'." Automotive News. May 9, 1988, pp. 4, 29.

Merritt, Necole and Bill Betts. "Saturn News Release." August 15, 1991, pp. 1-4.

McGrory, Mary. "Enlightenment From Saturn." The Washington Post. December 1, 1992, p. A2.

----- "The Ringers of Saturn." The Washington Post. November 29, 1992, pp. C1 & C5.

Miller, Krystal. "Saturn's Contract Concessions Bring Wages Near Parity With the Rest of GM." The Wall Street Journal. November 11, 1991, p. A6.

O'Toole, Jack and Jim Lewandowski. "Forming the Future: The Marriage of People and Technology at Saturn." Unpublished paper for Stanford University Industrial Engineering & Engineering Management. March 29, 1990.

Patterson, Gregory A. "GM's Saturn Corp. to Recall 1,836 Cars and Provide Owners With New Vehicles." The Wall Street Journal. May 13, 1991, p. B8.

Perriton, Alan G. Director, Materials Management, Saturn Corporation. Speech to University of Michigan 1991 Management Briefing Seminar. Traverse City Michigan. August 5, 1991.

----- "A Different Kind of Car - A Different Kind of Company - A Different Materials Management." Unpublished A.I.A.G. presentation by Vice President , Materials Management for Saturn Corporation. March 18, 1992.

"Quality Information for Students." Unpublished materials used to train new Saturn employees. Undated, pp. 1-3.

Rowand, Roger. "Plastic Saturn, Reatta Rage; DuPont's Bexloy Called Body Choice." Automotive News. June 17, 1988, pp. 1, 11.

Russell, John A. "Riney Agency Wins Saturn Ad Account." Automotive News. May 30, 1988, pp. 3, 26.

"Saturn Fact Sheet." Unpublished information used in training new Saturn employees. Undated.

"Saturn Unit's Workers Pass Labor Pact by 72% to 28%." The Wall Street Journal. November 15, 1991, p. A2:5.

Serafin, Ray and Laura Clark. "Dealer and UAW to Help Pick Saturn Ad Agency." Automotive News. March 7, 1988, pp. 6, 8.

Serafin, Raymond and Patricia Sirned, and Cleveland Horton. "Saturn's Ad Approach Wins Dealer Approval." Automotive News. November 19, 1990, p. 10.

Sinek, Jeremy. "Saturn Success Catches Canadians by Surprise." Automotive News. June 8, 1992, p. 33.

Smith, Roger B. Statement by Chairman General Motors Corporation

at the Saturn News Conference. Warren, Michigan, January 8, 1985.

"Spring, in Spring Hill." Video tape. Saturn Corporation Media Center.

Teahen, John K. Jr. "The Birth of Saturn." Automotive News Insight. December 31, 1990, pp. 4i, 6i, 8i.

Toczka, Mark. Interview with a Saturn salesman at Saturn of Fredericksburg, Virginia, September 1992.

Treece, James B. "Are the Planets Lining Up at Last for Saturn?" Business Week. April 8, 1991, pp. 32, 34.

----- "Getting Mileage From a Recall." Business Week. May 27, 1991, pp. 38-39.

----- "The Planets May be Perfectly Aligned for Saturn's Lift-Off." Business Week. October 22, 1990, p. 40.

"U.S. and Canada Car and Truck Production." Automotive News. September 28, 1992, p. 37.

"U.S. Car and Light Truck Sales, 9 Months-1992 vs. 1991." Automotive News. October 12, 1992, p. 38.

Wetzel, John J. "Managing the Interfaces for the Success of the Product, the Customer, the Company." Presentation to University of Michigan 1991 Management Briefing Seminar, Traverse City, Michigan, August 8, 1991.

White, Joseph B. "GM's Saturn Unit to Boost Output 33% This Month." The Wall Street Journal. August 9, 1991, p. A2:4.

----- "GM Struggles to Get Saturn Car on Track After Rough Launch." The Wall Street Journal. May 12, 1991, pp. A1 & A8.

----- "Saturn Recalls 30% of Its Cars in New Setback." The Wall Street Journal. February 14, 1991, pp. B1:6 & B8:3.

Whiteside, David. "GM's Bold Bid to Reinvent the Wheel." Business Week. January 21, 1985, pp. 34-35.

Whiteside, David, Richard Brandt, Zachary Schiller, and Andrea Gabor. "How GM's Saturn Could Run Rings Around Old-Style Carmakers." Business Week. January 28, 1985, pp. 126, 128.

"Why Tennessee?" Unpublished materials used for training new Saturn employees. Undated, pp. 1-5.

Womack, James P. "The Lean Difference: An International Productivity Comparison and the Implications for U.S. Industry."

Looking Ahead. Vol. XIII, No. 4, April 1992, pp. 3-9.

Zino, Ken. "GM's Big New Gamble--Saturn's in Orbit." Parade Magazine. October 7, 1990, p. 27.